

Remarks

Claims 1-15 and 17-27 are pending. Claim 1 has been amended in accordance with an Examiner's suggested change and to include a permanence feature to the changed state. Support is found on page 12, lines 26-32. New Claim 26 is based on claim 16 wherein the wording "said substituents C¹ and C² contains a π -electron system" has been amended to "said substituents C¹ and C² contains an extended conjugated π -electron system" as disclosed on page 7, 2nd paragraph of the present application and wherein the superfluous provisos have been deleted. The wording "that at least one of said substituents C¹ and C² contains an extended conjugated π -electron system which is in conjugation with the π -electron system of the heptalene core" means that the number of conjugated double bonds is at least two. New claim 27 is supported by the disclosure on page 24, 3rd paragraph of the Specification. No new matter has been added.

The amendment is substantially in the same form as the amendment which the Examiner refused to enter prior to the Request. The main difference is that claim 1 has been amended to adopt the Examiner's suggestion for overcoming a 112 rejection and to introduce a permanence feature into claim 1. The amendments will advance prosecution in this case. Since the Examiner refused to enter the Amendment after final rejection, Applicants trust that the resulting office action will not be made final.

The Examiner rejects claim 16 (now claim 26) under 35 U.S.C. 112(1) as containing subject matter that is not described in the specification. New claim 26 has eliminated the proviso of concern.

The Examiner rejects claims 1 and 25 under 35 U.S.C. 112(2) as being indefinite for failing to particularly point out and distinctly claim the intended subject matter. The Examiner asserts that the "to produce and/or process..." does not properly claim a physically differentiated state.

The present invention is drawn to a process or a method for information storage and data processing using substituted [4n]annulenes, not the [4n]annulenes per se (except the novel [4n]annulenes of claim 16) nor double bond shifts of [4n]annulenes. The key point is that the transition in the recited compounds produces a change in a medium containing the same that is discernible or identifiable by some detection means. Contrary to the Examiner's statement, this

essential property is embodied in the concluding phrase "having at least two distinguishable physical states". Claim 1 has also been amended as suggested by the Examiner to delete this phrase.

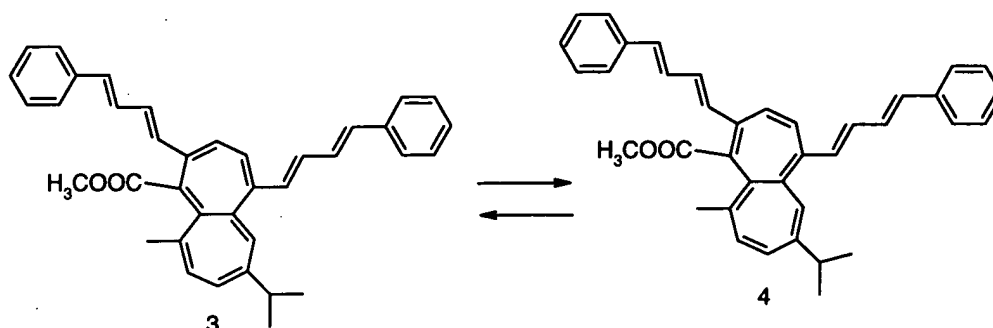
The Examiner rejects claims 1, 2, 6, 7, 11-14 and 25 under 35 U.S.C. 102 as being anticipated by an article entitled "Triplet-State Cis-Trans Isomerizations of a Bissstyrylcyclooctatetraene", by Ingjald Anger et al., J. Phys. Chem. 99, 650-652 (D1). The Examiner states that the claims do not require a stable or long term change in physical state. Applicants respectfully traverse this rejection.

As noted above, claims 1 and 25 both require a change in the physical state in recording medium that is readily discernible. Claim 1 has been further limited to require a change sufficient for use in information storage and/or data processing. D1 relates to the cis-trans isomerizations of Z,Z-, E,Z-, and E,E-1,5-bisstyryl-3,7-dimethylcyclooctatetraene. On triplet sensitized excitation, ZZ isomerized, via EZ as a ground-state intermediate, to EE with low quantum yields. D1 discloses neither double bond shifts in [4n]annulenes nor a method for information storage and data processing (cis-trans isomerizations are not double bond shifts in [4n]annulenes!). D1 does not disclose or suggest producing an article having at least two distinguishable physical states or processing the information (claim 1) or generating/processing two different conjugation steps (claim 25). D1 does not anticipate claims 1, 2, 6, 7, 11-14 and 25.

The Examiner rejects claims 1-7, 12, 13, 16-18 and 23-25 under 35 U.S.C. 102 as being anticipated by an abstract entitled "Synthesis of New Photo- and Thermochromic Systems Based on Cyclic Double Bond Shifts in Heptalenes" H.-J. Hansen et al. Chimia vol. 50, pp. 341 (7/8-1996) (D2). The Examiner refers to formulae 3 and 4. The Examiner maintains that the claims do not require anything more than isomerizations. Applicants respectfully traverse this rejection.

Claims 1 and 25 require the production of an article or medium capable of exhibiting at least two distinguishable and discernible physical states. Claim 1 has been further limited to require a change sufficient for use in information storage and/or data processing. D2 discloses that heptalenes such as 3 and 4 are interconvertible through a double bond shift that can be induced thermo- or

photochemically. 3 shows an intense absorption band at 433 nm, which is not present in 4. Irradiation of 3 at 438 nm converts the compound into 4, which on standing at 25 °C slowly reverts to 3.



D2 does not provide sufficient information about the synthesis of 3 and 4. Moreover, the fact that different physical properties arise from the double bond shift (UV/Vis absorption) does not provide any motivation to exploit 3 and 4 for information storage or data processing (cf. page 6, last paragraph of the present application).

D2 does not disclose or suggest producing an article having at least two distinguishable physical states or processing the information (claim 1), the novel compounds of claim 16 or generating/processing two different conjugation steps (claim 25). D2 does not anticipate claims 1-7, 12, 13, 16-18 and 23-25.

The Examiner rejects claims 1-7, 12, 13 and 16-25 under 35 U.S.C. 102 as being anticipated by an article entitled "Double-Bond Shifts in [4n] Annulenes as a New Principle for Molecular Switches: First Results with Dimethyl Heptalene-1,2 and 4,5-dicarboxylates", by H.-J. Hansen et al., Helvetica Chimica Acta vol. 79, pp. 2282-2315 (1996) (D3). Applicants respectfully traverse this rejection.

The filing date of the present application is December 10, 1996. D3 is published on December 11, 1996, i.e. after the filing date of the present application and, therefore, does not form prior art for the present application. Applicants previously submitted a Declaration signed by Dr. M. Volkan Kisakürek, the editor in chief of Verlag Helvetica Chimica Acta AG to establish the publication date. Applicants request that the Examiner reconsider and withdraw his anticipation rejection based

on D3.

The Examiner rejects claims 1-7, 12, 13 and 16-25 under 35 U.S.C. 102 as being anticipated by an article entitled "Synthesis and Dynamic Behavior of Chiral Heptalenes", by Klaus Hafner et al, Bull. Chem. Soc. Jpn., vol. 61, pp. 155-163 (1988) (D4). Applicants respectfully traverse this rejection.

Due to the amendment to claim 16 (as expressed in new claim 26) D4 does not anticipate the invention claimed therein. D4 teaches that cycloaddition reactions of azulenes with dimethyl acetylenedicarboxylate provide an excellent access to a large variety of substituted dimethyl 1,2-heptalenedicarboxylates. D4 does not disclose or suggest producing an article having at least two distinguishable physical states or processing the information (claim 1) or generating/processing two different conjugation steps (claim 25). D4 does not anticipate claims 1-7, 12, 13 and 16-25. Applicants request that the Examiner reconsider and withdraw his anticipation rejection based on D4.

The Examiner rejects claims 1-7, 12, 13 and 16-25 under 35 U.S.C. 102 as being anticipated by an article entitled "Formation of Cyclic ortho-Anhydrides of Heptalene-1,2-dicarboxylic Acids", by H.-J. Hansen et al. Helvetica Chimica Acta, vol. 70, pp. 1439-1460 (1987) (D5). Applicants respectfully traverse this rejection.

Due to the amendment to claim 16 (as expressed in new claim 26), D5 does not anticipate the invention claimed therein. D5 relates to the preparation of cyclic ortho-anhydrides of heptalene-1,2-dicarboxylic acids. D5 does not disclose or suggest producing an article having at least two distinguishable physical states or processing the information (claim 1) or generating/processing two different conjugation steps (claim 25). D5 does not anticipate claims 1-7, 12, 13 and 16-25. Applicants request that the Examiner reconsider and withdraw his anticipation rejection based on D5.

The Examiner rejects claims 1, 2, 6, 7, 11-14 and 25 under 35 U.S.C. 102 as being anticipated by an article entitled "Ring Inversion and Bond Shifting Energetics in Substituted Chiral Cyclooctatetraenes", by Paquette, L.A., Pure Applied Chem., vol. 54(5), pp. 987-1004 (D6). Applicants respectfully traverse this rejection.

D6 discloses a new methodology that permits quantitative assessment of ring inversion and bond shifting barriers within [8]annulene derivatives, in particular chiral cyclooctatetraenes. D6 does not disclose or suggest producing an article having at least two distinguishable physical states or processing the information (claim 1) or generating/processing two different conjugation steps (claim 25). D6 does not anticipate claims 1, 2, 6, 7, 11-14 and 25. Applicants request that the Examiner reconsider and withdraw his anticipation rejection based on D6.

The Examiner rejects claims 1, 2, 6, 7, 11-14 and 25 under 35 U.S.C. 102 as being anticipated by an article entitled "Novel pericyclic reactions in p-perimeter chemistry", by Hafner et al., Pure Applied Chem., vol. 65(1), pp. 17-25 (1993) (D7). Applicants respectfully traverse this rejection.

D7 relates mainly to the synthesis and rearrangement of 5, 5a, 10, 10a-tetrahydroheptalene derivatives. D7 does not disclose or suggest producing an article having at least two distinguishable physical states or processing the information (claim 1) or generating/processing two different conjugation steps (claim 25). D7 does not anticipate claims 1, 2, 6, 7, 11-14 and 25. Applicants request that the Examiner reconsider and withdraw his anticipation rejection based on D7.

The Examiner rejects claims 1-9, 11-14 and 16-25 under 35 U.S.C. 103 as being unpatentable over D2 or D3 in view of U.S. Pat. No. 5,438,561 (D9). D9 is cited as showing the use of photochromic compounds in polymeric binders. The Examiner alleges that it would be obvious to use the photochromic compounds shown in D2 or D3 in polymeric binders. Applicants respectfully traverse this rejection.

D3 is published after the filing date of the present application and, therefore, does not form prior art for the present application. D2 does not provide sufficient information about the synthesis of 3 and 4. Moreover, the fact that different physical properties arise from the double bond shift (UV/Vis absorption) does not provide any information on the possibility to use 3 and 4 for data processing (cf. page 6, last paragraph of the present application). D9 relates to a method for recording and reproducing information using an optical memory device being constituted by a transparent substrate, a recording film formed on the substrate and made of a resin containing a

photochromic material dispersed therein. Specific examples of the photochromic material are diarylethene derivatives and nitrospirothiopyran. However, D9 (as well as D2) does not contain any hint that substituted [4n]annulenes can be used in a method for information storage and data processing. Applicants request that the Examiner reconsider and withdraw his obviousness rejection based on D2 or D3 in view of D9.

The Examiner rejects claims 1-9, 12 and 16-25 under 35 U.S.C. 103 as being unpatentable over D2 or D3 in view of U.S. Pat. No. 5,432,873 ("D10"). D10 is cited as showing the use of photochromic compounds in optical switches. The Examiner alleges that it would be obvious to use the photochromic compounds shown in D2 or D3 in optical switches. Applicants respectfully traverse this rejection.

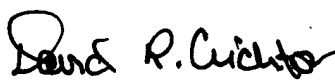
D3 is published after the filing date of the present application and, therefore, does not form prior art for the present application. D10 relates to an optical switch in which a compound including a photochromic material is placed between two optical waveguides. According to D10 examples of photochromic materials are derivatives of fulgide, anthracene, azobenzene, hydrazine, oxazone, diarylethene, salicylaldehyde, spiropyran, biimidazolyl and cyclophan (see D10, column 6, line 18 to 21). According to D10, column 5, line 61 to column 6, line 21 the photochromic material must meet specific conditions to be suitable for the optical switch according to D10. That is, not any photochromic material is suitable for information storage and data processing. Consequently, D10 does not teach or suggest the use of substituted [4n]annulenes in a method for information storage and data processing. D2 is distinguished for the same reasons given above. Applicants request that the Examiner reconsider and withdraw his obviousness rejection based on D2 or D3 in view of D10.

The Examiner rejects claims 1-7, 10, 12 and 16-25 under 35 U.S.C. 103 as being unpatentable over D2 or D3 in view of an extract from "The Applications of Holography", by H.J. Caufield et al. (D11). D11 is cited as showing that photochromic holography medium is conventional or well known. The Examiner alleges that it would be obvious to use the photochromic compounds shown in D2 or D3 in holographic media. Applicants respectfully traverse this rejection.

D11 contains a general disclosure that various recording media, including photochromic materials, have been used for holographic recording. No specific photochromic materials are mentioned in D11, however. Therefore, D11 does not teach the use of substituted [4n]annulenes in a method for information storage and data processing. D2 and D3 are distinguished for the same reasons given above. Applicants request that the Examiner reconsider and withdraw his obviousness rejection based on D2 or D3 in view of D11.

Applicants submit that the present application is now in condition for allowance. In the event that minor amendments will further prosecution, Applicants request that the Examiner contact the undersigned representative.

Respectfully submitted,



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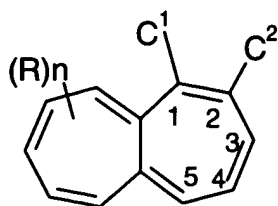
Amended Claims with Mark-Ups

1. (**amended**) Method for information storage and data processing comprising the step of thermo-inducing or photo-inducing double-bond shifts in substituted [4n]-annulenes which are substituted by at least one group comprising an extended conjugated π -electron system which is in conjugation with the π -electron system of the [4n]-annulene core, thus generating transitions between two different conjugation states with at least one substituent, to produce and/or process a material having at least two distinguishable physical states resulting in different UV/VIS spectra of the double-bond shifted isomers of [4n]-annulene, which provides the possibility to use distinct conjugation states (conjugation on-state and conjugation off-state) for information storage and data processing.

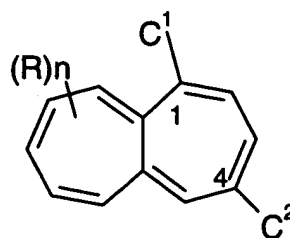
17. (Amended) [4n]-heptalenes according to claim ~~16~~26, whereby, C¹ and C² represent independently from each other a hydrogen atom, a methyl group, a phenyl group, an ethyl ester group, a methyl ester group, a (E)-PhCH=CH-group, a (E)-4-MeOC₆H₄CH=CH-group, a (E)-4-ClC₆H₄CH=CH-group, a 4-MeOC₆H₄-group, a -CH=CH-CH=CH-C₆H₅ group, a -CH=CH-C₆H₄NO₂-4 group, a -CH=CH-C₆H₄OMe-4 group, with the proviso that a heptalene being substituted by a methyl ester group at the position 1, a -CH=CH-CH=CH-C₆H₅ group at the positions 2 and 5, an isopropyl group at the position 7 and a methyl group at the position 10 is excluded.

18. (Amended) [4n]-heptalenes according to claim ~~16~~26, whereby said further substituents R are selected from the group comprising substituted or unsubstituted C₁-C₁₂-alkyl groups or photoactive diazo-containing groups, like azobenzene.

19. (Amended 2x) Method for the preparation of substituted heptalenes of the formula (I) or (II), according to claim ~~16~~26



(I)



(II)

whereby C^1 , C^2 , R and n are as above defined,
comprising the steps of

(a) obtaining a heptalene-dicarboxylate by a reaction of a correspondingly substituted azulene with acetylenedicarboxylate, and optionally

(b) transforming at least one carboxylic group or another substituent that was entered by the preliminary Diels-Alder reaction into the desired conjugated substituent having an extended π -electron system.

23. (Amended) An optical storage device comprising at least one substituted [4n]-annulene according to claim ~~16~~26.

24. (Amended) A non-linear optical device comprising at least one substituted [4n]-annulene according to claim ~~16~~26.